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IN THIS ISSUE

REGIONAL GEOGRAPHY IN A COURSE OF INSTRUCTION FOR THE SEVENTH GRADE

THE LESS-KNOWN REGIONS OF THE WEST INDIES
THEODOOR DE BOOY

WATER POWER IN CALIFORNIA
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WATER POWER IN CALIFORNIA

By ANDREW H. PALMER
U. S. Weather Bureau

The water problem in California, as in most states lying west of the Mississippi River, is one of great economic importance. The East has no water problem comparable in magnitude with that of the West. To give an idea of the significance of the problem as it exists today in California is the purpose of this paper.

California, the second largest state in the Union, includes approximately 160,000 square miles of the extreme southwest of the United States. Its latitude is equivalent in range to that part of the Atlantic coast extending from Boston to Savannah. Partly because of its position and partly because of its diversified topography it is a region of great climatic contrasts.

THE RAINFALL

Precipitation, the only element of climate here considered, ranges from one or two inches per year, on the average, in the Mohave Desert, to more than 100 inches per year in the Sierra Nevada Mountains. Within the state are also included the region of greatest known snowfall in the United States and regions in which snow of measurable amount has never been known to fall.

Figure 1 is an outline map of California showing the average annual precipitation in inches. It is readily apparent from the figure that there is a general increase in average precipitation from the southeast to the northwest and, furthermore, that the mountains are regions of heavy precipitation, while the interior basins and the southeastern plateau regions have deficient precipitation. Records show that there is an increase in average annual precipitation up to a height of 5,000 feet, in the Sierra Nevada, and a de-

crease above that height. The average annual rate of increase up to 5,000 feet is about 8.5 inches for every 1,000 feet. The ultimate source of practically all the rainfall in California is the Pacific Ocean. As the moisture from it is brought in by westerly winds, the eastern and northeastern slopes of the mountains receive much less precipitation than the western and southwestern slopes (1, 2). The rainfall is unequally distributed throughout the year, winter being the wet season, and summer the dry season. Toward the north the distribution of rainfall through the year becomes more nearly equalized. In southern California about 90 per cent of the annual precipitation occurs during the winter half-year, while in northern California the proportion is about 75 per cent.

The heaviest recorded precipitation for a calendar year in California is 156.90 inches, which occurred in 1911 at La Porte, Plumas County (Sierra Nevada), altitude 5,000 feet. Nearly every year at one or more stations precipitation is recorded exceeding 100 inches. As the greater part of the annual precipitation occurs during six months, extraordinary amounts sometimes fall within short intervals. The greatest amount recorded in one month is 71.54 inches, which fell during January, 1909, at Helen Mine, Lake County (Coast Range), altitude 2,750 feet. The greatest amount recorded in 24 hours is 16.71 inches, which fell January 16-17, 1916, at Squirrel Inn, San Bernardino County, altitude 5,280 feet. At Campo, San Diego County, altitude 2,543 feet, 11.50 inches of rain fell in 1 hour and 20 minutes, on August 12, 1891. The significance of these figures is apparent when it is realized that one inch of rain is equivalent to more than 100 tons of water to the acre.

By way of contrast, consider the record of Bagdad, San Bernardino County, altitude 784 feet, where no measurable rain fell from October 3, 1912, to November 8, 1914, inclusive—a period of more than two years. At Indio, Riverside County, 20 feet below sea level, no measurable rain fell from November, 1893, to January, 1895, a period of more than a year. At several stations in the Imperial Valley and at one in Death Valley, both of which depressions are below sea level, there have been periods of a year in which less than an inch of rain fell.

SNOWFALL

Since most of the precipitation comes during the winter season the elevated portions of the state have abundant snowfall. Tamarack, Alpine County (Sierra Nevada), altitude 8,000 feet, has an

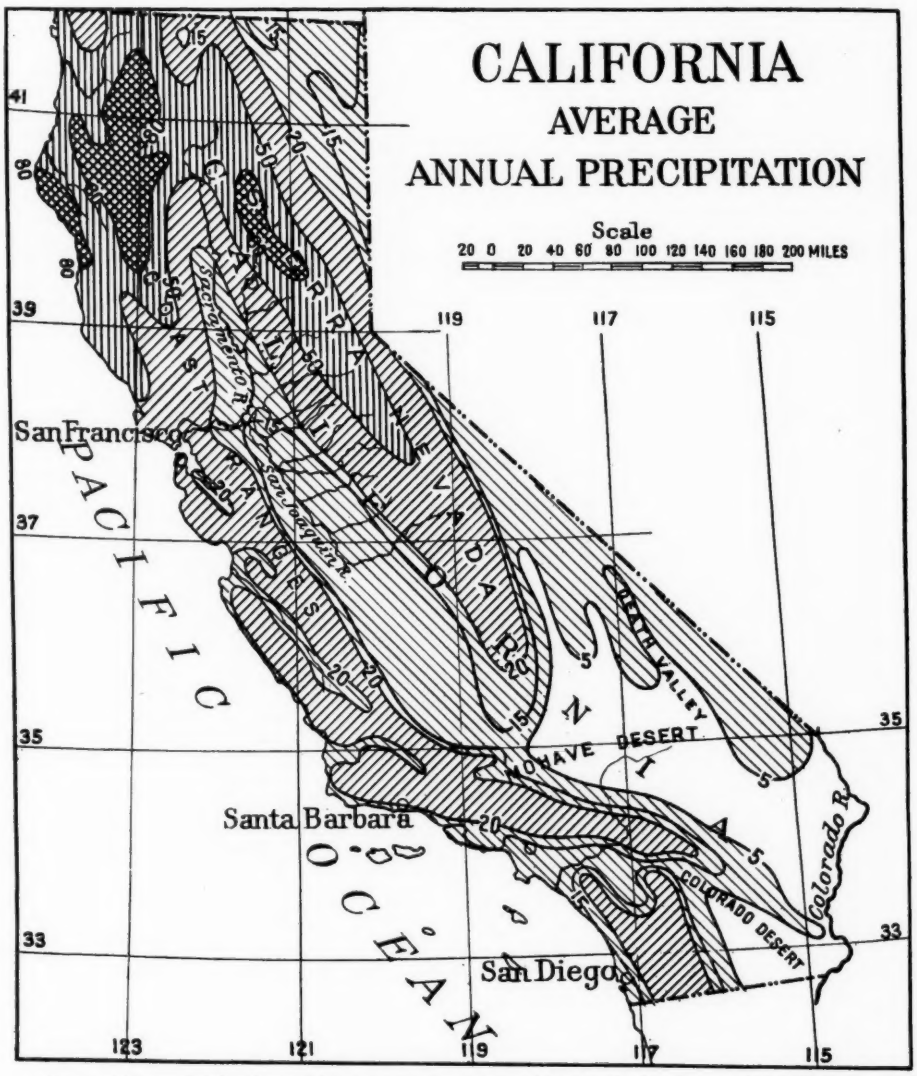

FIG. 1—Map of California showing average annual precipitation in inches. Scale 1:8,000,000. Based on the map prepared by J. B. Kincer and W. G. Reed showing the average annual precipitation of the United States, Advance Sheet 1, Atlas of American Agriculture, U. S. Department of Agriculture, Washington, 1917.

average winter snowfall of 43.4 feet, based upon a record of eight years. Nearly all of the stations in the higher portions of the Sierra Nevada Mountains receive more than 100 inches of snow

every winter. The greatest amount recorded during one winter is 73.7 feet, which fell at Tamarack during the winter of 1906-07. From 40 to 50 feet of snow has been known to accumulate on the ground at one time in the high Sierra Nevada. The importance of this snowfall has been pointed out by Professor R. DeC. Ward:

"The Sierra Nevada Mountains well deserve their name. To them California owes much, if not most, of her present prosperity and her promise for future growth and development. The many feet of winter snowfall which accumulate on the upper slopes mean millions upon millions of dollars each year to the farmers and fruit growers of southern California. Were all this precipitation to fall as rain, every winter would witness devastating floods, and every summer would wither and destroy the crops" (2).

WATER POWER: DEFINITION AND STATUS

As may be surmised from the foregoing data, California has a water problem of great complexity. The foundation of it lies in the nature of the precipitation, i. e. its irregular distribution both in time and place. Irrigation, floods, city water supply, and water power are all intimately related subdivisions of the general water problem. It is with the last subdivision and its relations to the foregoing that we are here concerned.

Water power, when available in a sufficient amount, is the ideal form of energy, combining a constant supply with a minimum of cost. Wind power is sometimes referred to as an ideal form of energy; but, unlike water movement, air movement cannot be controlled artificially, for which reason wind power must always remain of secondary importance when compared with water power. Water acts as a motive power by its weight, by its pressure or impact, or in both ways. When the motive power is weight alone the device employed is frequently a water wheel, like the antiquated mill wheels. When pressure or impact is involved the energy is made available by means of modern water wheels, turbines, or hydraulic pressure engines. In the modern hydraulic power plant the water is employed to operate turbines or water wheels which in turn drive electric dynamos, and the electrical energy thus derived is transmitted to and utilized at places far distant from the source of supply. This application of power is

a recent development, the first commercial enterprise of the kind having been established less than twenty-five years ago. It is because of the possibilities seen in hydroelectric development that water power has assumed a new significance within recent years.

FIG. 2—One of California's many beautiful falls, Vernal Falls in the Yosemite National Park. A potential source of electrical energy: height of falls, 400 feet. (Photograph by A. C. Pillsbury.)

In order to justify its development and use, electric power generated by falling water must be cheaper than steam-driven power, since it is, generally speaking, less dependable than the latter. This is due to unavoidable interruptions in the service

from lightning, breaks in transmission lines, low water, floods, or ice jams. The initial cost of installing a hydroelectric plant is much greater than that of a steam plant, since it requires the construction of reservoirs, generators, and transmission lines in remote and inaccessible places. However, when the installation is complete the cost of maintenance is only a small fraction of that of a steam plant, since it requires no fuel and but little labor.

NATURAL CONTROLS OF WATER POWER

There are five well-recognized factors which control the flow of streams and therefore determine the water power available at any time. With particular reference to conditions obtaining in California, these are as follows:

(1) *Climate.* For California the climatic features here involved and discussed at length in the introductory paragraphs may be summarized thus: deficient precipitation in the lowlands, abundant precipitation (mostly snow) in the mountains; nearly all of it occurring during the winter half-year, while the summer half-year is everywhere dry and hot with excessive evaporation and almost unbroken sunshine. All these features conspire to produce high water in the streams during the first six months of the year and low water during the latter six months.

(2) *Topography.* In contrast to much of the eastern United States the country west of the Missouri is characterized by physiographic immaturity. It is a region of marked topographic contrasts with swiftly flowing streams of sharp gradient and correspondingly high potentialities for power development. The states of Washington, Oregon, and California alone are estimated to have 40 per cent of the developable water power of the country. Moreover the collection of water in natural or artificial reservoirs at considerable heights in such a region makes possible the development of power plants where the head or pressure is great. (See Fig. 4.)

(3) *Geology.* The permeability of the underlying rock is an important consideration. In the Sierra Nevada Mountains, where most of California's water power is to be found, the rocks are of great variety, but they are mostly hard granites, more or less impervious to water and not easily eroded.

(4) *Vegetation.* Whether or not the headwaters and drainage basin of a stream are forested determines in large measure the rate of run-off. Generally speaking, when the headwaters of a stream are densely forested the run-off is slow and steady; while, if the forest cover has been removed or the basin is naturally bare of vegetation, the run-off is sporadic, and destructive floods are frequent.

(5) *Artificial agencies.* Reservoirs, either in the form of natural lakes or artificial dams, naturally affect the flow of streams to a large extent. In California there are comparatively few natural lakes of large size along the streams. Artificial dams, however, are numerous and increasing in number from year to year.

HISTORY OF HYDROELECTRIC DEVELOPMENT IN CALIFORNIA

The great modern developments of industrial power have been those connected with electricity and oil, and, while California is remote from commercial coal supplies, in both of these new sources of power the state ranks high. About 70 per cent of the power used comes from fuel oil and natural gas, and about 20 per cent from water power. But the oil output will soon have attained its maximum and will begin to decline, and the total power requirements increase from 10 to 15 per cent per annum.

The state of New York, largely because Niagara Falls is situated on its border, leads the Union in developed water power. California is second, exceeding in this respect the state of Washington, which has however a larger amount of developable power. Practically all of the water power is of the hydroelectric type, in the development of which California claims the honor of being a pioneer.

The first hydroelectric plants in California were primarily experiments, and the energy was used locally to operate mills and mining machinery. The first commercial hydroelectric high-tension transmission in the state was the plant erected in the town of Folsom in 1895. It supplied the city of Sacramento. Since that time development has been rapid. Today 19 power companies operate 80 plants, producing nearly 700,000 horse power and supplying electrical power to 596 cities and towns.

The progress of electrochemistry and the rapid industrial

development of California explain in a measure the rapidly increasing use of hydroelectric power. While agriculture has long been the leading occupation in the state and perhaps will remain the leading one for some time to come, manufacturing is increasing at a more rapid rate than is agriculture. According to the California Development Board the value of California manufactures has increased from $67,000,000 in 1870 to $750,000,000 in 1917.

Fig. 3—Mount Shasta. If the potential energy contained in the snows of Mount Shasta could be utilized by means of hydroelectric power it would be more than sufficient to operate all the railroads of California. (Photograph and copyright by C. R. Miller.)

Water Power in Relation to Irrigation

Successful agriculture requires that the land shall receive a minimum of 18 inches of water per year. As is indicated in Figure 1, a large part of California—including most of the southern part of the state, all of the San Joaquin Valley, much of the Sacramento Valley, and a portion of the northeastern plateau region—have an average annual precipitation of less than that amount. By means of artificial irrigation, however, much of this land has been reclaimed, and as a result California ranks high in agriculture, particularly in horticulture. The latest figures available, the Census of 1910, show that 39,352 (44.6 per cent.) of the 88,197 farms were

irrigated. The area irrigated was about 2,664,000 acres. In the 1916 report of the California State Board of Agriculture it is stated that 84 per cent of the irrigation water used in the state came from streams, 13.2 per cent from pumped wells, and only 0.6 per cent from artificial reservoirs.

Water power and irrigation are intimately related phases of the larger water problem, and neither can be discussed without a refer-

FIG. 4—Roe Lake, a natural reservoir whose capacity could be greatly increased by artificial means. (Photograph by A. A. Forbes.)

ence to the other. In water power development little or no water is consumed, as it is in irrigation. The power plants simply extract the potential energy of the water as it descends and make no further use of it after it has passed the water wheels or turbines. The power plants are situated in the mountains while the agricultural fields are in the lowlands and foothills. Hence it would appear that there should be no conflict in water rights. There has been, however, an unfortunate antagonism between users of irrigation water and power interests, an antagonism which to some extent has delayed water power development. The ranchmen desire the water to come down from the mountains in large quantities during the dry season, while the power plants can use it only at a regular

rate, more or less constant throughout the year. But the situation, due in considerable part to a misunderstanding and to a lack of information, is not hopeless. At the present time there are needed greater recognition on the part of the power interests of the water rights of the ranchmen and better knowledge among the latter as to the methods of modern hydroelectric development and the benefit to be derived from it. Mountain reservoirs can serve the double purpose of irrigation and power sources. The State Water Commission and the State Railroad Commission are rendering valuable service in attempting to harmonize the conflicting elements.

WATER POWER IN RELATION TO FLOOD CONTROL

Though much of the lowland of California has deficient precipitation, it is nevertheless subject to destructive floods. Notable floods occurred along the Sacramento and San Joaquin Rivers in 1907, 1909, and 1911, in the vicinity of Los Angeles in 1914, and in the vicinity of San Diego in 1916. The first named floods were due primarily to warm spells in midwinter, with rain falling in the Sierra Nevada while the ground was deeply covered with snow. The last-named flood was due primarily to excessively heavy rainfall throughout southern California. When it is remembered that most of the heavy precipitation comes within a period of six months and sometimes within a shorter period, the cause of floods can readily be understood; and when monthly and daily excesses of precipitation like those mentioned in the introductory paragraphs of this article occur, it is evident that floods also contribute another factor to the California water problem.

Basing his conclusion upon investigations made by the U. S. Geological Survey, Mr. M. O. Leighton states that 55 to 60 per cent of the flood waters of the country can be saved by the utilization of maximum storage capacity (3). Although the cost of such construction would be enormous in the aggregate, the saving that would accrue in relief from flood damages would soon return the entire investment. In by far the larger proportion of the river basins such a saving of flood waters would insure practically entire relief from flood damages. The construction of reservoirs necessary to prevent floods would, under proper management, involve an increase in the water power possibilities of the United States equal to about 60 million horse power.

CITY WATER SUPPLY

When cities are small their water needs can easily be satisfied; but when they attain the size of San Francisco or Los Angeles the domestic water supply becomes a matter of considerable importance and involves heavy expenditure. The development of the water supply in each of these cities merits attention.

At the present time San Francisco is constructing at an enormous cost an aqueduct from the Hetch Hetchy district which is designed to deliver by force of gravity a quantity of water somewhat in excess of 400 million gallons daily—under extreme conditions 500 million gallons. When completed the aqueduct from the intake to the center of San Francisco will be 189 miles long. When construction was begun, in 1912, the city did not propose in the immediate future to build any plant for the development of hydroelectric power. Power development was considered subordinate to domestic water supply. But the city planned carefully to conserve all reasonable opportunities for power development against the time when it would become expedient to use them.

Though at this present moment the aqueduct is not complete, the power is already needed. About one-half of the electric street railway lines in San Francisco are municipally owned, and plans are under way for the purchase of the remaining privately owned lines. Furthermore, a street electric lighting system is at present being installed which, when completed, will be one of the most efficient in the United States. Municipal needs for electric power have become almost as urgent as domestic water needs. In view of these conditions, a 4,000 horse power hydroelectric plant was installed on the Hetch Hetchy aqueduct and is already in operation. It is estimated that in three years San Francisco will have surplus power for sale and that the receipts from this source will practically pay interest on the cost of the mountain development of the system.

A few years ago Los Angeles, the metropolis of southern California, recognized that its future growth was dependent upon an adequate water supply. At huge cost an aqueduct 259 miles in length was constructed to reservoirs in the Owens Valley, near the eastern base of Mount Whitney. In its construction also power development was a subordinate consideration, though provision

was made for future utilization when the demand should justify the installation of power plants. In 1917 there were three hydroelectric power plants in operation along the Los Angeles aqueduct, and these were capable of generating 40,456 horse power.

FUTURE DEVELOPMENT

The U. S. Geological Survey is authority for the statement that the water power in California ranges from over 3,200,000 horse power at low water to 7,800,000 horse power at high water (4). In 1917 less than 8 per cent of the available power was being utilized. There are various indications that this proportion will be materially increased during the next few years. Rapid industrial development, increasing municipal needs of power for electric street and interurban railways and for street lighting, additional power for pumping irrigation water when no wind is available—all these demand accelerated hydroelectric development. In 1914 there was about 500,000 primary horse power used in manufactures. It is estimated that the demand in 1918 is about 50 per cent greater. Ocean steamers are given preference in coal deliveries, oil and labor are increasingly difficult to obtain, and the price of each is steadily rising. Increased hydroelectric development would ease the situation, and the benefits derived would extend beyond the borders of the state.

As water power consumes no fuel, its substitution for steam power would release to other uses all the extensive transportation facilities now engaged in moving fuel. It would also release a considerable volume of labor which could be used to advantage in other fields. In 1917 there were some 3,000 miles of electric railways in California, the greater proportion of which were operated by hydroelectric power. Eventually all of this mileage and more will be so operated. There were also over 12,000 miles of steam railroads in operation. In time a large portion of this mileage will be electrified. Plans are already under consideration by the Southern Pacific Railroad to electrify its mountain division. The Western Pacific Railroad crosses the Sierras along the Feather River Canyon, at the very edge of a mountain torrent in which more energy goes to waste each year than is generated in all the steam locomotives operated by that company.

The future of water power development in California, however, is not without its difficulties. Some of the undeveloped power sites are too remote from the market to be utilized at present, and an uncertain number are not yet commercial prospects. The initial cost of installation of a modern hydroelectric plant is relatively high, and for that reason water power development is necessarily delayed when the demands for capital are so varied and urgent as they are at present. In order to prevent unavoidable interruptions of hydroelectric power an auxiliary steam plant is necessary, and this adds to the cost. For sentimental reasons various waterfalls, which are situated in recreation centers like the Yosemite National Park and are aesthetically beautiful, will not be immediately available for development but must eventually be put to use. (See Fig. 2). Furthermore, California is a region of frequent earthquake disturbance. Weather Bureau records show that this is the region of greatest instability in the whole United States. However, engineers now take these seismic disturbances into consideration in planning dams and aqueducts, which, as at present constructed, are practically earthquake-proof so far as these frequent but slight disturbances are concerned.

While there are thus a few minor handicaps to water power development in California, they are relatively unimportant and are being eliminated. The possibilities for hydroelectric development in this state are so vast as to have attracted the interest of the most efficient engineers and the foremost financiers of the United States.

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HYDROELECTRIC POWER AND HUMAN GEOGRAPHY

A specific illustration of the importance of hydroelectric development has been given in the preceding article; the following short item will note some of the general features that characterize the movement from the geographic viewpoint.

A considerable part of human geography is written on the maps that show distribution of population. A density of population map of the world (see such a map as that in Bartholomew's Advanced Atlas of Physical and Political Geography) shows three great areas of dense population—three great human agglomerations—China with Japan, India, Western Europe. There is a nucleus of a fourth such area in North America. The two Asiatic agglomerations are ancient; those of Europe and America are new; they arose from the industrial revolution and are dependent primarily upon coal, the product that created a new industrial grouping in the Old World and encouraged emigration to the New World. The industrial discovery of coal is one milestone on the road of human progress; the recent discovery of hydroelectric power is another whose significance has scarcely been grasped as yet.

A New Resource in "Regions of Difficulty"

Hydroelectric power supplies a new resource to regions poor in the natural endowments that in the past have made for large populations. It is typically a mountain product though other topographic forms share also in its distribution, notably the ancient glaciated lands of northeastern North America and of northwestern Europe. Mountains of the temperate zone—and the same is in large part true of the glaciated lands we have mentioned—are likely to be regions of comparative poverty. In a classification by H. J. Fleure (1) of the regions of the world on the basis of the response they give to human work such are classed as "regions of difficulty." In them man must work hard for a mere livelihood, and the numbers who can so live are limited. Agricultural resources are restricted. Forest and pasture, if climate be suitable, afford the chief resources; but with these is associated only a scant population. The mineral wealth is not likely to be such as will support

a large or permanent population. The density of population must remain low unless some new resource can be exploited; recourse must be had to emigration. Of late years some mountain countries have found a partial solution of their problem by taking advantage of their scenery and bracing air to attract health and pleasure seekers. But the great promise for many of these "regions of difficulty" lies in their endowment of water power.

THE FRENCH ALPS AS AN ILLUSTRATION

Let us take an illustration from the French Alps, a region of ancient civilization where we may be sure man has not failed to make the most use of his natural opportunities. Here were first demonstrated the possibilities of the new motive force, though it was not the first industrial use of water power in the region which from Roman days had been famous for its metallurgical products. At the beginning of the nineteenth century there still flourished numerous small forges deriving their power from the old-time water wheel. They were ruined by the rise of steam power; industry shifted to the coal fields from which the Alpine valleys were remote. The situation in the French Alps may be compared with that in New England, where also manufacturing arose in response to water power. Though many of the New England mills were similarly abandoned on the introduction of steam power, those whose location was more accessible were able to survive (2).

During the last quarter century in the French Alps these unfortunate conditions have been reversed. Emigration has been stopped; growth has commenced. Within the region itself there have been several interesting redistributions of population. In the valley of Graisivaudan (right fork of the Isère) the population formerly concentrated on the right bank of the river, the bank more favorable for agriculture, has largely moved over to the left, shut in by steep slopes down which tumble the streams that are the source of the "white coal." It is the war, however, that has shown how great are the changes that hydroelectric development will bring into the region. Enemy occupation of the great industrial area of northern France and Belgium diverted manufacturing to the regions of Lyons and the French Alps. Here, in spite

of all the difficulties attendant on war conditions—shortage of raw material, of transport, and especially of labor—great advance has been made. In 1914 about 500,000 horse power was used; in 1916 738,000 horse power was in use, and many new installations were in the course of erection. The greatest activity is witnessed in the northern section of the Alps and centers about the old town of Grenoble, the regional capital (3). The French section of the Alps is not unique, of course, in hydroelectric development. Italy, poor in coal, is turning more and more to the power to be derived from her northern frontier. The development in Switzerland and in other neutral countries has recently been noted in the *Journal* (November, 1918). The influence of hydroelectric development on human geography is used as an illustration in the "Teachers' Manual of Geography for Grades VII and VIII" discussed elsewhere in this number.

INDUSTRIAL AND CIVIC ADVANTAGES OF ELECTRIC POWER

Electricity is a mobile force: power supply can be concentrated and then distributed. By centralization of power great economies can be effected. An investigation was recently made into the fuel situation in the United Kingdom, and the report issued on the findings of the committee proposed "to supply all industries with electrical power generated at big superpower stations, not more than sixteen in number for the whole country" (4). In the case of the United Kingdom such electrical energy will be largely derived from coal, but attention is also being directed to the undeveloped water power, especially of the Highlands of Scotland. This centralization of power, however, does not mean centralization of industry but actually the converse because of the transmissibility of the power. This is a feature that touches again upon the distribution of population: we can avoid the congestion that in the past crowded cities as great "conurbations" upon the coal fields. An excellent graphic illustration of this crowding may be seen in the two maps accompanying the article by Mark Jefferson, "The Distribution of British Cities, and the Empire" in the *Geographical Review,* November, 1917.

Closely related to this matter of population grouping is the matter of civic reform. The typically squalid town of the coal

field arose under conditions that our town planners and others interested in civic welfare seek to amend. All was not the fault of coal, but there is no question of the superiority of the new force from the standpoint of civic improvement.

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THE LESS-KNOWN REGIONS OF THE WEST INDIES

By THEODOOR DE BOOY

When one reads of the extensive geographical explorations that have been undertaken in far-off regions during the first decades of the twentieth century, and of the noteworthy results that have been achieved, it seems well-nigh incredible that there should still be large areas near at home which are comparatively unknown. It is not necessary for a geographer to sail for the Far East, the Arctic, or the Antarctic to find material for investigation. Lured by the attractions of distant parts, the investigator but too frequently overlooks the obvious and neglects opportunities that can be found nearer home. It is of such opportunities that we would speak.

Stretching all the way from the Florida coast to the northern shores of South America, the islands of the West Indies form the northern and eastern boundaries of the Caribbean Sea. Famed in history as the first regions seen by the discoverers of the Americas, the islands were speedily overshadowed in importance by the discoveries that took place directly afterwards and were subsequently eclipsed by the richer resources of the continents. As a result there exist large tracts in the West Indies which, strange as it

may seem, are almost unknown at the present time. Indeed in several instances the geographical student looks almost in vain for contemporary information and must perforce content himself with writings dating from the sixteenth and seventeenth centuries.

The Bahamas

We begin with the most northerly of the Antillean islands, the Bahamas. We shall not speak of the island of New Providence with its capital Nassau, as this is well known and a favorite resort for tourists desirous of escaping the rigors of the northern winter. But the Bahama Islands as a group are still so little known that in 1905 the Baltimore Geographical Society organized an expedition which had for its main object the exploration of the outlying islands of this archipelago. Despite the excellent work done by this expedition, there are still many members of the group about which our knowledge is of the scantiest. The island of Andros, for instance, has, according to reliable reports, been traversed but twice. This is the largest island of the entire group and, though several negro settlements exist on its eastern shores, is uninhabited in the interior. There are today numbers of Bahamians who implicitly believe that Andros is peopled with savage Indians, and one could hardly hire a native to accompany an expedition to penetrate that dreaded interior. It is probable, however, that Andros is about the most fertile island of the Bahamas, and large quantities of valuable cedar trees are known to exist but a short distance from the coast. Notwithstanding these attractions the settlement of this island appears to be something which none will undertake. Here, then, is a possibility for the geographer: to make a topographical survey of the interior, to locate roads which will enable future settlers to determine upon the areas best suited for cultivation, and to find those regions which present the most suitable living conditions.

Cuba

The island of Cuba still has several large areas of which our geographical knowledge is slight. What is perhaps the largest of them is found on the southern coast of the island, from Santiago de Cuba due west as far as Cape Cruz. It is here that the Sierra

Maestra raises its multifold peaks skyward. With the exception of one or two settlements on the coast, consisting of nothing more than a few fishermen's huts, the region is uninhabited and has no roads. This is a country of immense caves, not one in a hundred of which up to the present time has been visited. The highest crest of the Sierra Maestra (about 8,000 feet) is reported to have been climbed only once, and even this report does not appear to be reliable.

The extreme eastern end of the island also remains *terra incognita* to the geographer. So little known is this district that no longer ago than the year 1900 an expedition was sent thither by the Museum of the University of Pennsylvania to investigate the reported presence of a tribe of Cuban Indians. The ethnological results were disappointing as no pure-blooded Indians were discovered; but the district itself, a plateau of coral-limestone formation, was shown to possess some of the most fertile soil on the island and to be well worth further investigation. While it is partly inhabited, all communication takes place by water, and a guide familiar with the obscure trails leading through the interior is hard to find.

JAMAICA

In spite of the fact that Jamaica is one of the most densely populated islands of the West Indies, that it is the proud possessor of the best roads among them, that it is visited yearly by thousands of tourists, and that the Jamaican Government has prepared, in the past, maps of the island commendable for their completeness and accuracy, a large district still exists which apparently has only once been visited by an explorer. This is the so-called Cockpit Country, described by Mr. F. Cundall some few years ago. After leaving Maroon Town, which is now inhabited by the descendants of runaway slaves, this explorer visited the negro settlement of Accompong. He describes the region by saying that "at one time it gave the impression of a number of stunted cones rising from the plain; at another the feeling was one of a number of basins like to the Devil's Punch-Bowls of England; at all times, except where there was a clearing for corn, bananas, or bread-kind, it appeared thickly wooded—mahogany, cedar, mahoe, Santa

Maria, and broadleaf being prominent, and mosquito wood and red shinglewood and other lesser known woods being pointed out by our guide. . . ."

HAITI AND SANTO DOMINGO

Until two years ago, when Haiti and Santo Domingo began to be patrolled by the efficient constabulary organized under the supervision of officers of the United States Marine Corps, the republics, with their hostile attitude to foreigners, held out but scant attractions to traveler or geographer. Now that these hazardous conditions have changed for the better, this island affords fascinating opportunities for geographical research. The great Tiburon Peninsula, forming the southern district of Haiti, is traversed by two mountain chains which not only have not as yet been ascended but which are the reported abode of a remnant of the tribes originally inhabiting the island. It is the belief of the writer that these reports are erroneous, but there is a possibility that a considerable percentage of Indian blood may be found amongst the semisavage inhabitants who for political and criminal reasons have sought refuge in this unexplored country.

The island of Gonave, lying in the great bay of which the Tiburon Peninsula forms the southern arm, is today inhabited by escaped criminals from the capital of Haiti, Port au Prince. In consequence, this island has been shunned by explorers, and its interior is as yet unknown to science.

The large lakes lying on the frontier between the republics of Santo Domingo and Haiti are as yet enveloped with a veil of mystery that has been but partly lifted. The larger of the two, Lake Enriquillo, especially needs to be studied since it possesses considerable archeological and historical interest. This mysterious lake is reported to be connected with the sea—it lies 100 feet below sea level—and, according to the natives living near its shores, sharks and dolphins abound in its waters. One of the islands in this lake was the last refuge of the chief Enriquillo and a remnant of original Arawac Indians who settled here in order to escape being enslaved by the Spanish *conquistadores.*

To the south of this lake lies the great peninsula of Beata. Of all regions in the West Indies, this is preëminently the one that

is unknown. No map can be found which shows in a reliable manner the topography of this large area. The coasts are occasionally visited by fishermen, but the interior appears to be less known than was "darkest Africa" in the middle of the nineteenth century. When one considers that here is an area not less than 100 square miles in extent which may hold some of the richest minerals of the republic, it is astonishing that no efforts have been made to investigate its possibilities.

It is not only the peninsula of Beata that needs to be investigated. The Dominican Republic has many another rich chamber that remains to be unlocked. The Constanza Valley in the center of the island, with an elevation of some 4,000 feet, can boast of no settlers whatsoever to exploit its wonderful climate and great agricultural possibilities. Mount Tina, to the south of this valley, the highest mountain in the West Indies (over 11,000 feet), has not been climbed to date. Northward is a region which in pre-Columbian days was the abode of countless thousands of aborigines but which today is almost deserted.

The republics of Haiti and Santo Domingo have many other areas that would well repay scientific investigation. The gold mines of Santo Domingo, the petroleum and coal deposits of Haiti, the iron ore which is said to be found along the shores of the peninsula of Azua will in time be investigated and developed.

THE LESSER ANTILLES

Although the islands of the Lesser Antilles are far smaller than those that have been mentioned, this group also can claim many spots that have remained unvisited by the scientist.

St. John, the smallest of the Virgin Islands of the United States, an island which in slave times was of some importance, is today a forgotten speck upon the map. It has wonderful bays, which are visited by none save local fisherman, despite the fact that they rank as the best-protected harbors of the West Indies.

A short distance to the east lies the British island of Tortola, which vies with St. John in beauty and also in geographical obscurity. Further out lies Anegada, "the misty island," generally obscured by dense fogs. It has been aptly named "the graveyard of ships." The shores of this lonely outpost of the

Caribbean are washed by dangerous and varied currents which never have been systematically studied.

In the chain of islands that sweeps southward as far as the South American continent are found islands belonging to France, Great Britain, and The Netherlands, some of them bearing names familiar only to specialists in West Indian geography. The multitudinous attractions of the Lesser Antilles are scarcely known and deserve to be more fully exploited. The former strongholds of the dreaded Carib Indians are today inhabited by whites, negroes, East Indians, and Chinese. The largest of these islands is Trinidad, which almost touches the Venezuelan mainland. Only half of this most fertile island has been settled, and its resources in petroleum and asphalt are as yet but partially utilized.

Thus we find in the West Indies many an opportunity for the geographer and student of natural history. There is no need to go far from the United States to discover virgin fields awaiting investigation and development. With the opening and operation of the Panama Canal, the eyes of the world are centering more and more upon the Caribbean Sea and its fringe of islands. With the increased traffic that is bound to come, it is believed that the searchlight of science will soon illuminate the remaining dark spots of this most interesting part of the world.

REGIONAL GEOGRAPHY IN A COURSE OF INSTRUCTION FOR THE SEVENTH GRADE

A NEW MASSACHUSETTS MANUAL

Geographical method in our schools has passed through various phases. Within a few decades the old locational and political geography has given place to the physiographic stage, and this in turn to a stage emphasizing the study of economic and commercial facts. Following the general development of geographical science school method is now tending towards regional treatment. For many years leading European and American geographers have expounded regional geography. In Great Britain the "new" geography has been especially associated with the name of Her-

bertson. In the United States Dryer has been one of the foremost exponents of that geography, which he has described as "the bright, consummate flower of geographical science, from which the best fruit of scientific method and discipline is to be obtained"(1). But progress here has been somewhat slow; the average textbook does not yet treat of geography from the regional standpoint, though there is the exception of Dryer's "High School Geography" in which Part III is devoted to a systematic treatment of regional geography. A particular significance therefore attaches to a recent publication of the Massachusetts Board of Education, the "Teachers' Manual of Geography for Grades VII and VIII" (2).

PURPOSE OF THE MANUAL

The manual is distinguished by the emphasis it places on regional geography. This will be shown by the reprint below of a section of the manual. Before this is done, however, it will be necessary to glance at the aim and purpose of the manual. In the first place the authors assign to geography a high rank in the school curriculum. "It applies so widely to the immediate problems of human life, it possesses so broad a cultural value, and is so important in developing the powers of reasoning, of investigation, and of initiative that the committee feels that it deserves a prominent place in the upper grades or in the junior high school." As a basis for the courses proposed for the seventh and eighth grades it is assumed that before the end of the sixth grade all the continents will have been studied in elementary fashion and that the two succeeding years may be available for covering the field with new method and emphasis. The United States and Europe, because of their importance, are selected for intensive study, the United States being preferably assigned, other things being equal, to the seventh grade where it is to be supplemented by brief study of Canada and the chief countries of South America.

REGIONAL TREATMENT AND THE PROBLEM METHOD

The discussion of method stresses regional treatment, as has been stated, and use of the problem as a method of approach. The problem method has been recently discussed in the *Journal* (3). In the manual the teacher may find some useful hints regarding

its employment. The case for regional treatment may be quoted at length:

> This type of geography teaching is based upon the division of the earth into natural geographic regions to which human activities are closely related. It sums up the important facts with reference to a given region and shows their relation to man. It utilizes the best of each of the other methods. Thus it demands a knowledge of location and of political geography but uses these as a means of understanding the climate, commerce, or international relations. It also requires a knowledge of physical features but uses these as a means to understanding man's occupations, habits, and character. Far more than its predecessors, this method is characterized by a conscious attempt to meet the needs of the pupil as a member of society. This type of geography has been taught by progressive teachers for years. Now that the studies of the upper grades are being reorganized, the time seems ripe to accord to it a worthy place in every school.

The outline for study of the regional geography of the United States recognizes the following "natural geographic" regions:

(*a*) North Atlantic Lowland
(*b*) South Atlantic Lowland
(*c*) Appalachian Highland
(*d*) North Central Plains
(*e*) South Central Plains
(*f*) Rocky Mountain Region
(*g*) North Pacific Slope
(*h*) South Pacific Slope

The classification is simple and practical, but it is well to point out here that, unlike a political classification, it is not absolute. According to the geographic factors stressed the classification will vary in the hands of different interpreters. Those who are interested in pursuing the subject farther should look up the papers, "The Subdivision of North America into Natural Regions," by W. L. G. Joerg, and "Natural Economic Regions," by C. R. Dryer, published in the *Annals of the Association of American Geographers* (4).

Finally it is intended that study of the natural regions be followed by study of the political divisions. Regarding the relations between the two divisions and the emphasis to be placed upon them opinions will vary, and it would be interesting to learn how this works out in practice.

Below there follows a section reprinted from the manual by permission of the Massachusetts Board of Education (5).

WORK OF THE SEVENTH GRADE

I. Human Geography of the Natural Regions of the United States

Since the available textbooks do not deal systematically with natural regions, the committee has felt it desirable to define those of the United States and Europe and to include in this manual a brief statement of the human geography of selected regions. A study of these regions may well serve as an introduction to the study of political divisions as given in the textbooks. Thus the pupil is introduced to the United States or Europe by a study of the way in which nature leads the people of one region to live differently from those of another, and thus divides the world into natural regions which may or may not coincide with man's political divisions. In connection with each continent this study may be finished in a few weeks or expanded to two or three months at the option of the teacher.

The following descriptions of the various regions are not exhaustive, nor do they suggest novel facts. They merely illustrate some of the ways in which the pupils may be led from a prominent human interest to a clear and broad geographic concept. Other human interests may equally well be taken as the starting point. It seems to be unnecessary for the purposes of this manual to include descriptions of all the geographic regions of the United States or of Europe, and no reference in this connection has been made to the other continents. Enough of this type of treatment is given, however, to illustrate the method.

1. The North Atlantic Lowland

The North Atlantic Lowland includes a strip of land from 30 to 50 miles wide, extending from northern Maine to the Potomac River. In general, it reaches back from the coast to the point where the hills begin to become mountains. Though hilly in the north it is flat in the south. The irregularity due to the submergence of the coast multiplies the advantages of the Lowland by providing an abundance of good harbors for commerce and fishing.

The dominant feature of this narrow coastal strip is a closely spaced series of industrial and commercial cities. Lying between Portland, Me., and Washington, D. C., about 1 per cent of the area of the United States contains one-fifth of its population, does one-third of the country's manufacturing, provides work for one-third of the immigrants from foreign countries, uses two-fifths of all the cotton produced in the country, and carries on two-thirds of the country's foreign commerce. All this is true largely because the Lowland is within comparatively easy reach of Europe, the climate is invigorating, the harbors are commodious, and water power is abundant. For three hundred years the Lowland has been the place that Europeans have chiefly thought of as they planned for emigration to America or carried on commerce with the people across the sea.

Since good farm land is not abundant here, agriculture has never been of first importance. The people have been obliged to turn to other occupations. Before machinery was common the people of the North Atlantic Lowland engaged largely in ocean commerce, whaling, and the slave trade. Later they undertook manufacturing. For this purpose they brought to their homes the cotton of the South and the coal and iron of Pennsylvania and states farther west, but they used the water power of their own rivers. Being within easier reach of Europe than was any other part of the country, the Lowland was the first to learn from that continent the art of manufacturing; and it still derives great profit from its relative proximity to Europe because the immigrants from the Old World usually land on its shores, where it is easy to secure them for factory labor.

In some respects it is unfortunate that hilly and even mountainous spurs from the Appalachian Highland extend into the Lowland and make the surface rough so that good farm land is scarce. The little farming possible, however, is well done. Since most of the level land lies near the coast and surrounds the bays where the cities are located, the farmers devote themselves largely to raising vegetables, poultry, and fruit and to producing milk for the city markets. So well is the land cultivated that this 1 per cent of the country's area raises 3 per cent of the crops, and produces more per acre than any other section.

Specimen Problems

Main Problem.—Why should the North Atlantic Lowland have more large cities than any other region of the United States?

Minor Problems.—1. From a list of the sixty largest cities of the country, to be found at the back of your geography textbook, select those that are located in the North Atlantic Lowland. Prove that no other natural region of the country contains so many.

2. Relation of the leading cities of the North Atlantic Lowland (those in the list you have made) to good harbors. Which are located on good harbors? Does any other region have so many good harbors?

3. Relation of the leading cities to rivers. Which are located on navigable rivers or canals? Which are located at waterfalls? Does any other region have better opportunities for river cities?

4. Relation of these cities to Europe as compared with the relation of other cities of the country. What advantages are there in this relation?

5. Position of the leading cities in respect to coal mines.

6. What effect has the climate of this Lowland as compared with that of other regions of the country in producing an energetic people? What effect does this have upon the growth of cities?

7. How early was this Lowland settled as compared with other parts of the country? How, then, has age helped the growth of the cities here?

Conclusion.—(Under this head the answer to the main problem is to be given in the form of a brief summary of the results of the minor problems.)

2. THE SOUTH ATLANTIC LOWLAND

The South Atlantic Lowland consists of the level plain or gently hilly country extending from the Potomac River to the Gulf of Mexico. On the west it is bordered by the eastern slope of the Appalachians, but farther south it is arbitrarily separated from the South Central Lowland by the boundary between Georgia and Alabama. Although five or six times as large as the North Atlantic Lowland, it has less than half as many people, does only one-seventh as much manufacturing, carries on only one-fifteenth as much foreign commerce, and uses no more cotton in its mills, even though the cotton grows right there. It has only one foreigner to more than fifty in the northern Lowland. These conditions are due partly to the fact that the climate is admirably adapted to cotton and tobacco raising and to the negro, but not so well to the white man of northwestern Europe. They are also due to the distance of the South Atlantic Lowland from Europe and to the scarcity of good harbors along its coast. These conditions tend

to drive people inland instead of holding them near the sea. Moreover, an inner border of mountains hinders trade much more than do the mountains on the western side of the North Atlantic Lowland. The swampy, and in many places unhealthful, coast with its few and poor harbors caused the early settlers to press inland till they reached the gently rolling inner strip with its deep, rich soil where cotton and tobacco thrive. Hence commerce and fishing did not flourish and, when the time came for manufacturing, the people were deriving such prosperity from their farms that they did not care to try other occupations. In fact, agricultural labor was in so great demand that there was little to spare for manufacturing, and negroes were brought from Africa in order to raise big crops of cotton to sell to the North Atlantic Lowland and England. Today the presence of tobacco in the north, and cotton farther south, is causing manufacturing cities to grow up in the interior, or piedmont, section of the South Atlantic Lowland, but the coast cities do not grow rapidly. There is little immigration because of (1) few ports, (2) a warm climate, (3) few manufactures to supply work, and (4) the presence of the negro to furnish labor on the farms.

Specimen Problems

Main Problem.—Why are Fernandina, Fla., and Savannah, Ga., the leading ports of the world for "naval stores"?

Minor Problems.—1. What are "naval stores"? Why are they so called?

2. What trees produce naval stores? Where do these grow in the United States?

3. What parts of the United States and what countries of the world use large quantities of naval stores?

4. Where are these ports in relation to the places where naval stores are produced and the places where they are used?

Conclusion.—(To be stated in the form of a brief summary of the results of the minor problems.)

3. THE APPALACHIAN HIGHLAND

The Appalachian Highland, a long, narrow strip extending from the mountains of Maine southwest through the White Mountains, Adirondacks, Alleghany Plateau, and Appalachian Mountains proper to northern Alabama, is the lumber yard, coal

bin, and pleasure resort of the eastern half of the United States. The northern end differs little from the southern, for the difference in latitude is partly offset by the higher elevation of the southern. Throughout much of its length the ruggedness and coolness of the mountains forbid agriculture, so that forests grow everywhere, and lumbering is the chief occupation. The forests and the ruggedness of the section combine to make travel difficult and to make it impossible for people to live there in large numbers. In certain localities the sparse population is uneducated and backward. Such conditions would be more prevalent if it were not that a long fertile valley extends through the Highland almost from end to end between the mountains on the east and the plateau on the west. In the North, in such regions as the Adirondacks and White Mountains, the presence of great numbers of summer visitors helps to bring prosperity, but this influence is only beginning to be felt in the South.

The center of the Appalachian region is quite different from the rest. In the first place, this is where the Highland can be crossed most easily. From New York an easy route by the Hudson Valley and Lake Champlain leads across to Montreal, while the still easier route by the Hudson and Mohawk valleys leads to the Great Lakes. Therefore several cities, like Albany and Utica, have grown up, but New York has reaped the chief benefit from this situation by being the seaport which can most easily handle the products of the great Central Plains. Farther south, in Pennsylvania and Maryland, the valleys of the Delaware, Susquehanna, and Potomac also furnish routes across the Appalachian Highland, although not so good as that of the Hudson-Mohawk Valley. It is fortunate that just where the climate and position of the North Atlantic Lowland most favor rapid development, it is easiest to cross the Highland and reach the Great Central Plain.

A second reason why the center of the Appalachian Highland differs from the extremities is found in the great deposits of coal in Pennsylvania and West Virginia. Therefore in this region mining and manufacturing are more important than lumbering, and in consequence there are found such cities as Pittsburgh, Wheeling, Johnstown, and Scranton. The factories are not like

those of the North Atlantic Lowland, however, for they are concerned with turning coal into coke, with smelting iron ore, and with making machinery, rails, and other steel and iron products. Around Birmingham, Ala., "the Pittsburgh of the South," the presence of coal and iron causes the low southern tip of the Appalachian Highland to be somewhat like the center. Apart from its coal and its forests the Appalachian Highland is chiefly important as a barrier. In the future, however, its use as a playground will become more and more prominent.

Specimen Problems

Main Problem.—Why are the Adirondack Mountains one of the most famous summer resorts, while the North Carolina Mountains are rarely visited?

Minor Problems.—1. How do the Adirondack Mountains compare with the North Carolina Mountains in respect to:

(*a*) Height of the mountains and the presence of forests?

(*b*) The warmth and length of the summer of the neighboring lowlands and the consequent need of a cool place for recreation?

(*c*) Proximity to large cities?

(*d*) Comparative number of railroad lines entering the two regions?

(*e*) Wealth of the neighboring regions and the ability of the people to afford vacations?

2. Will the North Carolina Mountains ever be as popular a summer resort as the Adirondacks?

Conclusion.—(To be stated in the form of a brief summary of the results of the minor problems.)

4. The North Central Plains

As "cotton is king" in the South, so "corn is king" in the northern half of the great grassy plains that extend from the western base of the Appalachian Highlands to the eastern base of the Rocky Mountain Region. This is the home of the farmer. With a quarter of the country's area and a third of its people this section raises half of the food, has half the cows and horses, keeps 60 per cent of the swine, and raises three-fourths of the corn, oats, and barley produced in the whole country. The North Central Plains provide the country's food in much the same way that the North Atlantic Lowland provides the manufactures and handles the foreign commerce. With a climate that makes people energetic, with deep, rich soil, and with vast expanses of level surface where

roads and railroads are easily built, such a region is most favorably conditioned to provide enormous quantities of food for the workers in the factories farther east and in Europe. It has its own manufacturing region around the Great Lakes, where there are cheap transportation facilities and abundant coal. Automobiles, farm machinery, cutlery, and hundreds of other kinds of iron and steel products are manufactured. Away from the coal beds and the lines of easy transportation by water, the factories are less numerous and are chiefly those that grind wheat, make butter, can vegetables, prepare meat, or otherwise use farm products. Such manufacturing is quite different from that of the smoking steel factories of the center of the Appalachian Highland, or the humming textile mills of the North Atlantic Lowland. With its abundant food, prosperous farmers, stimulating climate, and easy transportation, the North Central Plain lacks only a seacoast and good opportunities for recreation to give it almost ideal geographic surroundings.

Specimen Problems

Main Problem.—Routes of transportation are more numerous in the North Central Plains than in any other *equally large* region in any part of the world, except the western lowland of Europe. What conditions have made this possible?

Minor Problems.—1. Lakes: (*a*) What are the opportunities for lake transportation? (*b*) What is the combined length of the lakes? (Use scale on map.) (*c*) Are there to be found anywhere else so many large lakes that join one another? (*d*) What is the origin of these lakes?

2. Rivers: (*a*) What navigable rivers are there in the North Central Plain? (*b*) What is the combined length of the navigable parts? (*c*) What relief of the land allows the rivers to be navigable for so great a distance? (*d*) Why are these rivers not used more for transportation?

3. Canals: (*a*) What canals have been dug to permit transportation from one lake to another? (*b*) What canals connect rivers with lakes? (*c*) Why are the lake-to-lake canals so extensively used and the lake-to-river canals so little used?

4. Railroads: Look at a railroad map of the United States and notice the close network of railway lines covering the North Central Plains. (*a*) How has relief favored the building of these lines? (*b*) How have the number and wealth of the inhabitants encouraged railway building?

5. Roads: Roads are very numerous all over the North Central Plain. How has their extension been influenced (*a*) by relief; (*b*) by fine soil; (*c*) by the presence of farms everywhere?

6. In General: (*a*) What products are raised in this region that are easily transported to markets? (*b*) Which transportation routes have been favored by the presence of coal? (*c*) Where are the coal fields?

Conclusion.—(To be stated in the form of a brief summary of the results of the minor problems.)

5. The South Central Plain

The South Central Plain consists of the central plains south of the southern boundaries of Colorado, Kansas, and Missouri.

6. The Rocky Mountain Region

The treatment of this topic and the preceding one on the South Central Plain should be developed in accordance with the plan used for the other regions.

7. The North Pacific Slope

It is strange that one of the best parts of the United States should have remained almost uninhabited until a half-century ago. The North Pacific Slope, between the crest of the Cascade Mountains and the sea, is blessed with one of the best climates in the United States both for health and for agriculture. It is one of the most beautiful regions. It has splendid harbors and easy water communication, and possesses abundant natural resources in the form of timber, coal, and other minerals. Yet a half century ago, it had only one inhabitant to every five hundred in the United States. Today comprising about one-fiftieth of the country's whole area, it has about one-fiftieth of the population, and is growing more rapidly than any other part of the country. The reason the North Pacific Slope, comprising the western part of the states of Washington and Oregon, was so long neglected is that it is comparatively remote. The Cascade Mountains on the east and Siskiyou Mountains on the south are formidable barriers. Then, too, the great Pacific Ocean on the west separates it from China and Japan. The coast is so rainy and rugged that few people can live there. For the foregoing reasons the veritable gem of country comprising the Willamette and Puget Sound valleys between the Olympic Range and the Cascades remained unused almost to our own day. Now it has become one of the country's finest agricultural regions. Compared with the North

Atlantic Lowland, it cannot carry on so much commerce because it is too far from the great markets. In spite of this, cities like Seattle are beginning to do much manufacturing to supply the needs of the Pacific coast. The moist slopes of the magnificent mountains are covered with the finest kind of forests, where some of the Douglas firs rise to a height of 300 feet. So abundant are forests that nearly half of the states of Washington and Oregon has been placed in forest reserves by the United States government. Wood is so plentiful that Seattle is one of the chief wood-working centers of the country.

Specimen Problems

Main Problem.—Suppose the prevailing wind of the North Pacific Slope were an easterly instead of a westerly wind. What differences in the life of the region would be found?

Minor Problems.—1. The present distribution of rainfall. How much is there (*a*) on the coast; (*b*) in the Willamette and Puget Sound valleys—for example, at Portland and Seattle; (*c*) on the eastern side of the Cascade Mountains?

2. If the winds came from the east, what parts of this region would receive the greatest rainfall; the least?

3. Consider the relation of such winds to the ocean and the continent. What parts of the United States would the dry portions probably resemble?

4. Would there be any forests? If so, where would they be? How would they compare with the wonderful forests that now cover the Olympic Mountains?

5. Would the population be as abundant as now? What sort of occupations would the people probably follow?

Conclusion.—(To be stated in the form of a brief summary of the results of the minor problems.)

8. The South Pacific Slope

The most surprising thing about the South Pacific Slope, which embraces California from the crest of the Sierras to the ocean, is the number of products in which it stands first. Most people know that California rivals Colorado as a gold-mining state and that it stands first in raising oranges and grapes. Few, however, realize that it also stands first in raising melons, string beans, plums, asparagus, and walnuts. One-tenth of all the country's melons, fruits, and nuts come from this region. It raises one-seventh of

the string beans, nearly one-third of the plums and prunes, and more than one-third of the asparagus. As for oranges, half of those produced in the United States are from the South Pacific Slope, while two-thirds of the grapes and four-fifths of the walnuts come from there.

In spite of its wonderful achievements in agriculture, however, the South Pacific Slope is not very densely populated, for it contains vast areas that are either too mountainous or too dry to support many people. Nevertheless, it has as many inhabitants as the Rocky Mountain Region, which is six times as large.

Four great natural resources have in turn been the mainstay of the South Pacific Slope. Before the coming of the white man, the Indians, not knowing how to use many of these resources, were very poor and degraded. The Spaniards brought cattle and so were able to use the abundant grass—the first important resource. California might still be a great cattle country, as it was in the days of the old missions, if other occupations were not more profitable. One of these occupations is mining. It began in the middle of the last century when "prospectors" found that gold was an important resource of the western slope of the Sierras. The people who came for gold had to be fed, and they began to use still another resource—the fertile soil. On account of this, California acquired fame because of its vast fields of wheat and barley. Cereal farming was so profitable that it banished cattle raising from the better watered parts of the country. Then a fourth resource—the water of the rivers—was used. By means of irrigation the raising of fruit and vegetables became so profitable that in large areas it took the place of cereal farming. This will probably be the great enduring industry of the country, for agriculture of this sort is the chief occupation in other subtropical countries, such as Italy and Syria, which resemble California in having abundant rain in winter and a long, dry period in summer.

Specimen Problems

Main Problem.—Why do so many people like to visit southern California?

Minor Problems.—1. The kind of climate: (*a*) temperature (amount of variation from day to day and from season to season); (*b*) rainfall (amount, season, number of rainy days); (*c*) character of the season.

2. Character of the scenery: (*a*) mountains; (*b*) forests; (*c*) vegetation of the irrigated areas; (*d*) deserts; (*e*) coast.

3. Irrigation: Why should life in an irrigated fruit region be attractive?

4. Manufacturing: Is there much or little in southern California? Why? Does this condition make the region attractive? What sort of people does it attract?

5. Many people come to southern California for their health. Which of the conditions suggested above are especially attractive to them?

Conclusion.—(To be stated in the form of a brief summary of the results of the minor problems.)

BIBLIOGRAPHICAL REFERENCES

(1) C. R. Dryer: Regional Geography, *Journ. of Geogr.*, Vol. 11, 1912-13, pp. 73-75.

(2) Teachers' Manual of Geography for Grades VII and VIII, *Massachusetts Board of Education Bull. 97*, Boston, 1918. The bulletin was prepared by a Joint Committee, the members of which were: B. Holmes Wallace, Ellsworth Huntington, Sumner W. Cushing, and Leonard O. Packard, aided by contributing committees, the Massachusetts Council of Geography Teachers, the Boston Council on History and Geography, the Committee of Massachusetts Superintendents on Course of Study in Geography for Grades VII and VIII.

(3) M. E. Branom: The Project-Problem Method in the Teaching of Geography, *Journ. of Geogr.*, Vol. 16, 1917-18, pp. 333-338.

(4) W. L. G. Joerg: The Subdivision of North America into Natural Regions: A Preliminary Inquiry, *Annals Assoc. Amer. Geogrs.*, Vol. 4, 1914, pp. 55-83. Makes a survey of classifications by various authors, each classification being shown on a map.

C. R. Dryer: Natural Economic Regions, *Annals Assoc. Amer. Geogrs.*, Vol. 5, 1915, pp. 121-125.

(5) The manual includes a reference list of helpful books. Under the heading "General Textbooks and Reference Books" is included Mill's "International Geography" (D. Appleton & Co.), in which, it should be remembered, is W. M. Davis's description of the United States.

THE WOOL PROBLEM DURING THE WAR

Wool is one of the raw commodities that have received special attention at the hands of belligerents during the past years of warfare. Multiplied armies created a multiplied demand for warm clothing far out of proportion to the needs of an equal number of men in civilian life—a demand that could not be gainsaid but had to be satisfied if the highest efficiency of those who were to engage in battle was to be brought into play. The resources of the nations involved were taxed to the utmost to meet this demand, and the produce of other nations has of necessity been imported in large quantities to eke out the insufficient local

output. Experts have studied the situation; stocks on hand have been inventoried; production, imports, exports, and consumption have been carefully surveyed; and ingenious conservation devices have been put into practice to limit civilian usage to a minimum. The "wool problem," however, is likely to remain for some time.

AVERAGE ANNUAL CONSUMPTION IN THE UNITED STATES

Reference to the United States and the wool problems that arose in this country upon our entry into the war will throw much light upon the general situation, for, with the possible exception of Great Britain, there has been a striking parallel in all countries—namely, enlarged demands, shortage in supplies, and the imperative need of importing more wool despite the inadequate shipping facilities.

The United States in the years immediately preceding hostilities consumed an average annual amount of approximately 500,000,000 pounds of wool in the grease, that is the wool as shorn from the sheep's back. Upon being cleansed and scoured such wool shrinks to about 50 per cent of its original weight. On the basis of 100,000,000 population this sum provided for a per capita consumption of approximately 5 pounds per year. A computation of this kind, however, assumes an evenly distributed consumption which is not in accordance with facts. The infant does not consume as much as the adult, nor the negro of the South as much as the white man of the North. For the per capita consumption of men eligible for military service about 10 pounds would be a safer average.

UNITED STATES ARMY REQUIREMENTS

Had this average continued upon the induction of these men into the newly created armies of the United States when she declared war against Germany, there would have been no wool problem. An army of 4,000,000 men would have consumed 40,000,000 pounds of wool. Had the per capita average for civilian men even been doubled or tripled upon their assumption of military duties, there would have been no serious wool problem. That much more wool could have been imported with ease. However, our 4,000,000 men in arms were scheduled to consume the scarcely credible total

of roughly 500,000,000 pounds per annum—an amount equal to that consumed in peace times by a population of a 100,000,000. Almost over night the wool requirements of this country had advanced 100 per cent.

Every uniformed man had to be provided with warm woolen underwear, socks, shirts, suits, overcoats, caps, blankets, and other articles made out of heavy, good quality wool. Recently the War Department estimated the individual needs of the fighting men for these articles to be as follows in terms of raw wool:

Complete initial equipment	71 lbs.
Annual renewal—service in the United States	42 "
Annual renewal—service in France	75 "

Compare this with our estimate of 10 pounds for the same men when in civilian life! The "doughboys" certainly are kept in trim as concerns warm clothing and coverings. Their tremendous needs precipitated the wool problem.

GROWTH AND DECLINE OF IMPORTS DURING THE WAR

Even in pre-war years the United States was a heavy importer of wool. Domestic output sufficed for little more than 50 per cent of the demand. Production of wool in this country had gradually declined from 328,000,000 pounds in 1909 to 286,000,000 pounds in 1915, at which figure it has remained practically constant. The average annual import of wool for the years 1912 to 1914 approximated 215,000,000 pounds.

Although the United States had not then become a participant in the European struggle our imports during the first two years of war displayed an enormous increase, and for 1916 they totaled 445,000,000 pounds. The reasons for these larger totals were two, namely, (1) diminished imports of woolen manufactures and the consequent increased dependence on domestic fabrics and (2) enlarged exports of woolen cloths, blankets, etc. to the belligerent countries and to neutrals other than those on the European Continent.

In 1917, despite the fact of the entry of the United States into the war, there was a falling off in the wool import in consequence of the acute shortage of tonnage on the high seas.

In connection with the shortage of transportation the sources from which the United States draws its supplies of raw wool should be noted. Australia, Argentina, New Zealand, Uruguay, and the Union of South Africa, in the order of importance, are the leading exporters. The distances intervening between these countries, all situated in the southern hemisphere, and the United States necessitates long hauls by sea.

GOVERNMENT CONTROL THE SOLUTION OF THE PROBLEM

Insufficiency of wool imports, however, was not to be reflected in an insufficiency of military clothing and equipage. Military needs in advance of civilian needs was a principle rightly laid down by the authorities very early in the war. The government inaugurated an option on all wool imports and put into practice sundry schemes for the conservation of wool in civilian clothing. Later the domestic output was completely taken over by the authorities, and licenses to import wool were granted solely to government agencies. The government thus came into complete control of all wool. Allotments to manufacturers for the civilian trade were practically nil. Fortunately stocks of cloths and clothing on hand with manufacturers and dealers and available for civilian use have been sufficiently large in this country to ward off a shortage.

Government control and commandeering of wool have been the order of the day during the war in every belligerent country. Great Britain especially has exercised this governmental right over the crop of her colonies, with the exception of British South Africa, and has provided herself and her Allies with needed supplies. In 1916-17 approximately 70 per cent of the better grade wools exported by the leading producing countries originated in the British colonies. Great Britain's control over the wool supply of the world is therefore evident. She has already contracted for Australia's produce until one year after the war. To what extent she will continue control after the cessation of hostilities is at present a matter of conjecture. Certain it is, however, that the peace conference will give attention to the wool problem.

A. Y. COWEN

NOTES OF CURRENT ECONOMIC INTEREST

A Project of Reindeer-Raising in the Canadian Northwest. A quarter of a century ago reindeer were introduced into Alaska for the purpose of making the native economically independent. The introduction has been successful beyond expectations. His herd provides the native and his family with food, clothing and transportation and thus prevents him from becoming a charge on the Government. And the industry proves a powerful agent of civilization. Data on it may be found in the annual reports, "Work of the Bureau of Education for the Natives of Alaska," published by the Bureau of Education in Washington in whose province the work lies. In favorable locations the industry has become a financial success and steps have been taken to extend it as a commercial undertaking; shipments of reindeer meat, for instance, have been made to Seattle.

This success has stimulated an enterprise reported to be under way in the Canadian Northwest (Raising of Reindeer in Alberta, *Commerce Reports,* January 13, 1919). It is not the first time that such an attempt has been made in western Canada. Some years ago a herd was brought into northern Alberta from Labrador where reindeer had been successfully introduced by Dr. Grenfell. But climatic conditions proved unsuitable. The new enterprise proposes to carry on its operations in the barren lands farther north (north of Alberta province) in a region where conditions more closely resemble those under which the Alaskan herds flourish. The undertaking is primarily a commercial enterprise, the intention being to furnish reindeer meat for the markets of Canada and the United States, "presumably that the demand for western beef for shipment to England may not leave the west without enough fresh meat for its own use." Edmonton will be the gateway through which the reindeer products will pass for distribution. In addition it is planned to interest the natives in the industry. Should this prove successful the civilizing influence will be as important as the commercial in the opening-up of the country.

New Ranking Among the Copper-Producing States. Not long ago Michigan's wonderful copper mines gave that state first rank as a producer of copper. Then the marvelously rich ore bodies at Butte began turning out copper at an ever-increasing rate and Montana passed Michigan. A few years ago Arizona passed both Michigan and Montana and has since held first place, producing in 1917 as much copper as the next three states in order together produced (777,000,000 pounds). Utah has pushed forward and occupies third place, Michigan having sunk to fourth. The vast importance of the Arizona deposits in the world's copper supply is realized when we recollect that the United States contributes 70 per cent of the world production of this metal. R. H. WHITBECK

The Banana Industry. Great as is the present-day scope of the banana trade, its beginning, which was dependent on improved transportation, is

comparatively recent. The New England sea captain who first brought the fruit to the United States as an experiment and thus introduced it to international trade, died only a year or so ago (C. T. Mason: The Banana Ports, *Dun's Review*, September, 1918, pp. 48a to 48d). The rise of the banana trade has transformed the economic life of the Caribbean countries. The unhealthful coastal plains of the mainland were formerly practically deserted. Today there are flourishing plantations served by railways and ports with improved sanitation all dependent on the banana. Islands of the West Indies threatened with ruin on decline of the sugar industry have found a new source of prosperity in this fruit. Particularly is this true of Jamaica, now the greatest of banana-producing countries with an annual export of 17,000,000 bunches. Here the industry has created one of the great banana ports of the Caribbean, Port Antonio, now the second town of Jamaica.

GEOGRAPHICAL PUBLICATIONS

The Virgin Islands: Our New Possessions and the British Islands. By Theodoor de Booy and John T. Faris. 292 pp.; maps, ills., bibliogr., index. J. B. Lippincott Co., Philadelphia, 1918. $3.00. 8½ x 5½.

The Virgin Islands of the United States of America. By Luther K. Zabriskie. 339 pp.; maps, ills., index. G. P. Putnam's Sons, New York, 1918. $4.00. 8½ x 6.

Our recent acquisition of the former Danish West Indies gives a new point of departure for the teaching of the geography of the West Indies. These islands may be taken as a type study for the West Indies, for they show many of the distinguishing characteristics of the region as a whole, both their chequered career due to the fortunes of war and the vicissitudes of physical events and of commerce. During the seventeenth and eighteenth centuries the West Indies were a center of economic and political interest for the chief powers of Europe. This condition is still reflected in the varied ownership of the islands—in the numerous flags represented there. Drought, hurricane, and earthquake have at various times devastated the islands. Decline of the sugar trade, their chief source of prosperity, ruined many a family. The introduction of steam navigation brought changes in trade movements in the region, particularly affecting St. Thomas which lost its old position as a collecting and distributing center. The recent opening of the Panama Canal has again revived the strategic importance of this island.

The teacher will find material for study of the Virgin Islands in the two books listed above. The very readable volume by Messrs. de Booy and Faris will be found helpful in presenting a clear picture of the islands. The volume by Mr. Zabriskie is more statistical in character and is valuable for reference purposes. Both books are well illustrated.

AMERICAN GEOGRAPHICAL SOCIETY

WORK IN PREPARATION FOR

THE PEACE CONFERENCE

During the past year the American Geographical Society has had the privilege of rendering a public service which is unique in the history of the country. A detailed account of this service is published in the January number of the *Geographical Review*. A brief outline is given here to make clear the importance of the following announcement—the issue by the Society of a series of base maps and block diagrams.

DATA FOR THE PEACE CONFERENCE

Over a year ago President Wilson authorized Colonel House to organize forces to gather and prepare data for the use of the peace commissioners. To this organization, which became known as the "Inquiry," the American Geographical Society offered its building as headquarters. The Society's map collections and library and other facilities for research were also put at the disposal of the Inquiry. The organization included about one hundred persons, among them distinguished historians, economists, geographers, and men of affairs. Among the geographers attached to the Inquiry and now in Europe attending the peace conference in advisory capacity are Isaiah Bowman, Director of the American Geographical Society, acting as Chief Territorial Specialist; Mark Jefferson, Michigan State Normal School, as Cartographer; Major D. W. Johnson, Columbia University, and Major Lawrence Martin, University of Wisconsin, for special problems.

GEOGRAPHY, ECONOMICS, EDUCATION

The scope of the work undertaken by the Inquiry has been world-wide, though naturally attention has been concentrated on European conditions.

Besides the fields of political and diplomatic history and international law the inquiry has covered questions of

Geography.

(a) Economic geography.

(b) Political geography: strategic frontiers; topographic barriers.

(c) Cartography: maps to illustrate every kind of distribution that bears on peace problems, such as: (a) peoples, (b) minerals, (c) historical limits, (d) railways and trade routes, (e) crops and live stock, (f) cities and industrial centers, (g) religions.

(d) Irrigation: present development; possibilities in general reconstruction.

Economics.

(a) International: raw materials, coaling stations, cable stations, port works, tariffs and customs unions, free ports, open ports.

(b) Regional: Industrial development, self-sufficiency, traffic routes in relation to boundaries and material resources, including food, minerals, water power, fuel, etc.

Education.

(a) Status in colonial possessions.

(b) Condition in backward states.

(c) Opportunities of oppressed minorities.

PREPARATION OF MAPS

In every phase of the work need of the map has been demonstrated. Maps were needed to show not only all manner of territorial boundaries but also distributions of peoples, populations and their local densities, religions, economic activities, distribution of natural resources, trade routes, both historical and potential strategic points, etc. For these purposes accurate base maps were required. Such maps, showing rivers, railways, towns, administrative divisions, have been prepared by the American Geographical Society. They cover Europe, Asia, and Africa, each area being mapped in the detail required by its problems.

This unique series of base maps proved so important that it was adopted by the War Department and prescribed by its Committee on Education and Special Training for use in all colleges and universities where units of the Student Army Training Corps were located.

WIDE DISTRIBUTION OF MAPS DESIRED

The present series is a first step in popular education in national and international ideas and plans through the language of the map, for most persons a new language, but one made more or less familiar through the past four years of war. Public interest in maps and geography should be maintained and fostered in every educational agency. The issuance of this series is a challenge to the schools to take up and render an invaluable service to the country.